

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization International Bureau



(43) International Publication Date
9 September 2005 (09.09.2005)

PCT

(10) International Publication Number
WO 2005/081929 A3

(51) International Patent Classification⁷: **G01L 3/02**,
3/10, 3/12, 3/14

(21) International Application Number:
PCT/US2005/005597

(22) International Filing Date: 24 February 2005 (24.02.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/547,168 25 February 2004 (25.02.2004) US
60/562,652 15 April 2004 (15.04.2004) US
11/010,578 14 December 2004 (14.12.2004) US

(71) Applicant (for all designated States except US): **CALIFORNIA INSTITUTE OF TECHNOLOGY [US/US]**; 1200 East California Boulevard, MS 201-85, Pasadena, CA 91125 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **BARGATIN, Igor**

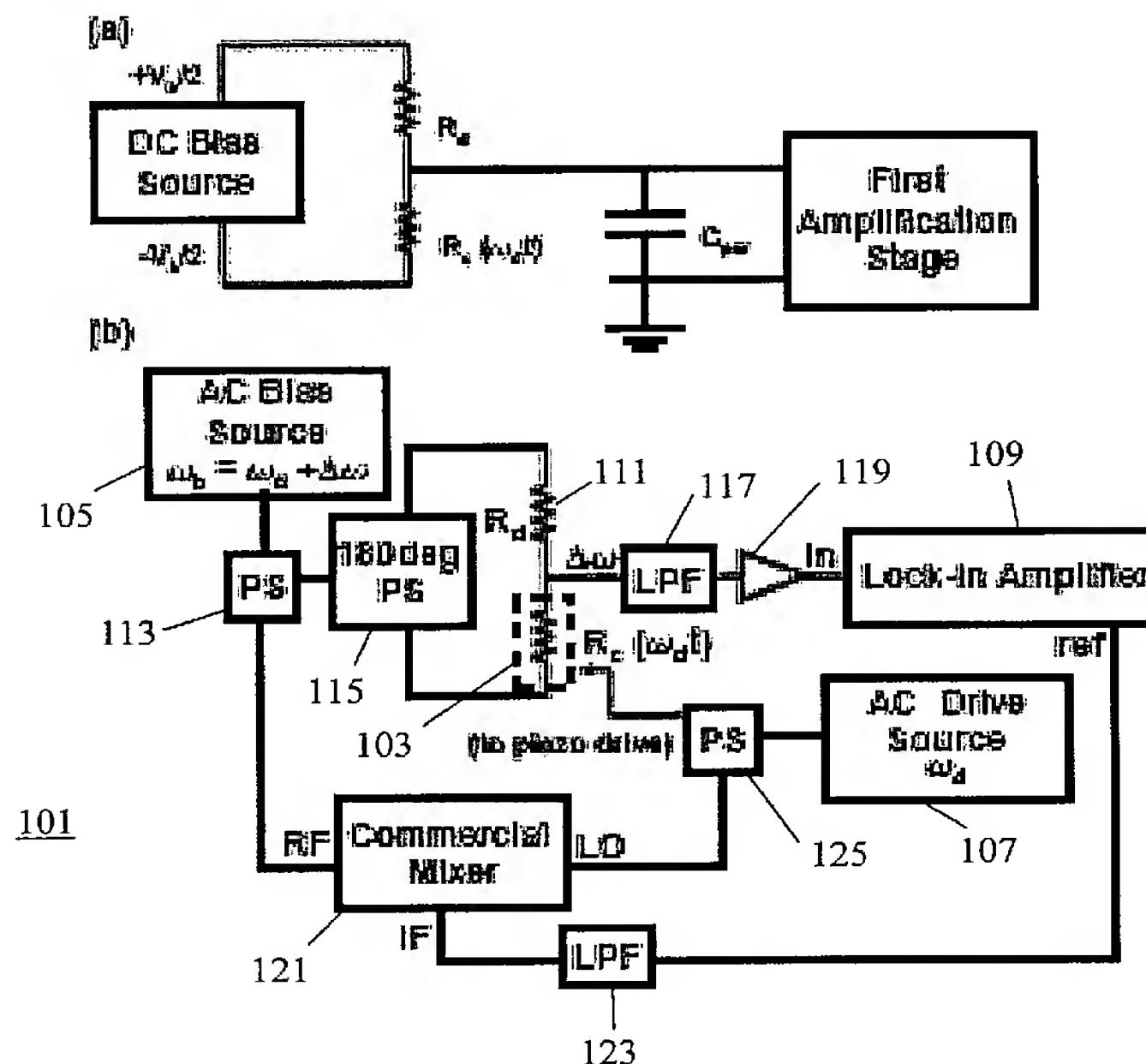
[RU/US]; c/o California Institute of Technology, 1200 E. California Blvd., MS 201-85, Pasadena, CA 91125 (US). **MYERS, Edward, B.** [US/US]; c/o California Institute of Technology, 1200 E. California Blvd., MS 201-85, Pasadena, CA 91125 (US). **LI, Mo** [CN/US]; 170 S. Chester Ave, #4, Pasadena, CA 91106 (US). **ARLETT, Jessica** [CA/US]; c/o California Institute of Technology, 1200 E. California Blvd., MS 201-85, Pasadena, CA 91125 (US). **GUDLEWSKI, Benjamin** [US/US]; c/o California Institute of Technology, 1200 E. California Blvd., MS 201-85, Pasadena, CA 91125 (US). **ROUKES, Michael, L.** [US/US]; 1420 San Pasqual, Pasadena, CA 91106 (US). **YOUNG, Darren, K.** [US/US]; c/o California Institute of Technology, 1200 E. California Blvd., MS 201-85, Pasadena, CA 91125 (US). **TANG, Hong, X.** [CN/US]; 1111 Blanche Street, #103, Pasadena, CA 91106 (US).

(74) Agents: **MAEBIUS, Stephen, B.** et al.; Foley & Lardner LLP, Washington Harbour, 3000 K Street, N.W., Suite 500, Washington, DC 20007-5143 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,

[Continued on next page]

(54) Title: DETECTION OF RESONATOR MOTION USING PIEZORESISTIVE SIGNAL DOWNMIXING



(57) Abstract: A system containing a micro-mechanical or nano-mechanical device and a method of operating the same is provided. The device includes a resonator and a piezoresistive element connected to the resonator. The method includes AC biasing the piezoresistive element at a first frequency, driving the resonator at a second frequency different from the first frequency, and detecting a mechanical response of the resonator at one or both of a difference frequency and a sum frequency of the first and second frequencies.

WO 2005/081929 A3



CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO,

SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- *with international search report*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(88) **Date of publication of the international search report:**

20 October 2005

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.